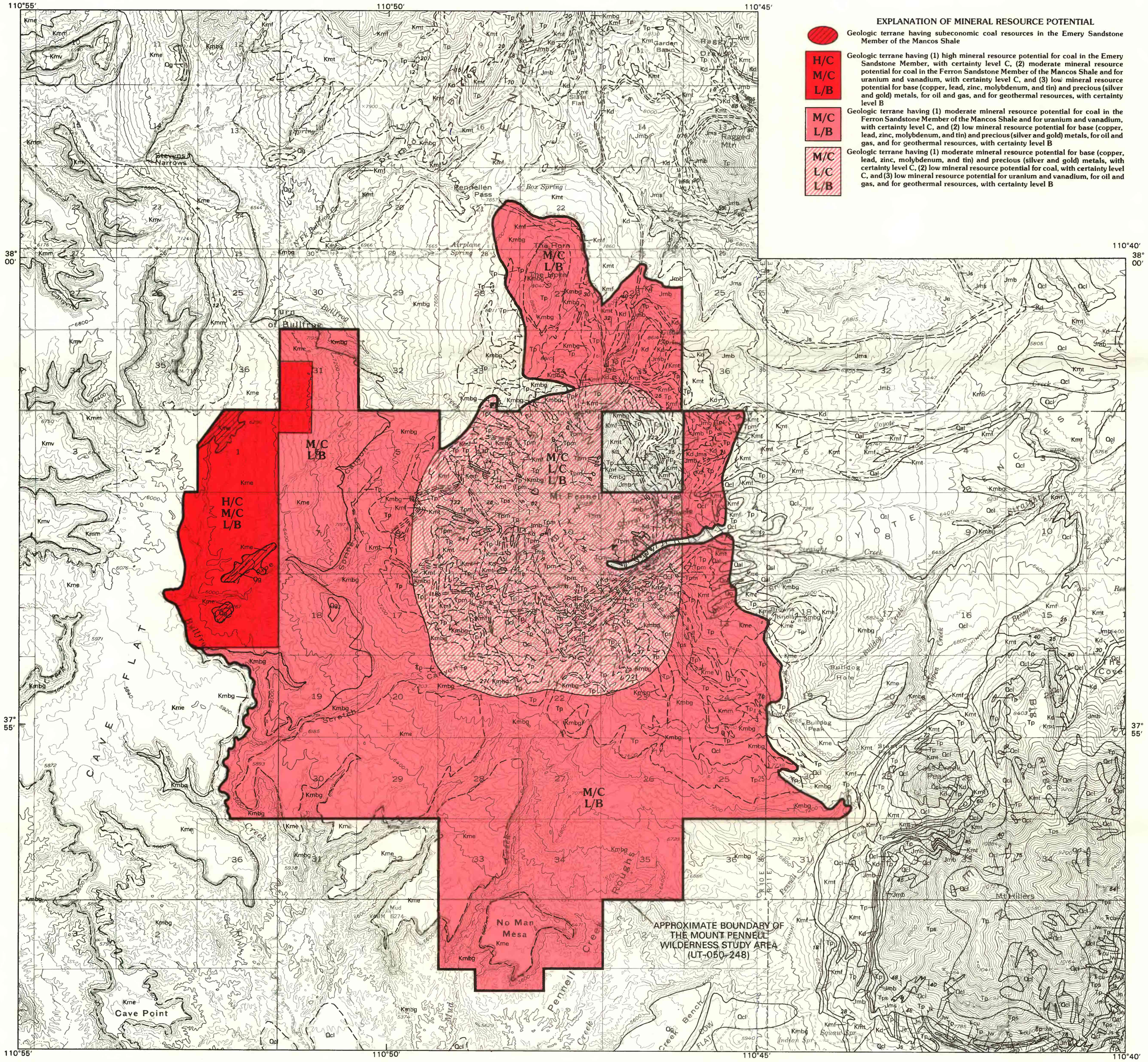


Base from U.S. Geological Survey, 1:62,500
Mt. Hillers, 1952; Mt. Pennell, 1953;
Mt. Ellen, 1962

13½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1975

SCALE 1:50 000
1 ½ 0 1 2 3 MILES
1 .5 0 1 2 3 KILOMETERS
CONTOUR INTERVALS 80 FEET
DATUM IS MEAN SEA LEVEL

UTAH

Geology from Larson and others, 1985

EXPLANATION OF MINERAL RESOURCE POTENTIAL

Geologic terrane having subeconomic coal resources in the Emery Sandstone Member of the Mancos Shale

H/C M/C L/B Geologic terrane having (1) high mineral resource potential for coal in the Emery Sandstone Member, with certainty level C, (2) moderate mineral resource potential for coal in the Ferron Sandstone Member of the Mancos Shale and for uranium and vanadium, with certainty level C, and (3) low mineral resource potential for base (copper, lead, zinc, molybdenum, and tin) and precious (silver and gold) metals, for oil and gas, and for geothermal resources, with certainty level B

M/C L/B Geologic terrane having (1) moderate mineral resource potential for coal in the Ferron Sandstone Member of the Mancos Shale and for uranium and vanadium, with certainty level C, and (2) low mineral resource potential for base (copper, lead, zinc, molybdenum, and tin) and precious (silver and gold) metals, for oil and gas, and for geothermal resources, with certainty level B

M/C L/C L/B Geologic terrane having (1) moderate mineral resource potential for base (copper, lead, zinc, molybdenum, and tin) and precious (silver and gold) metals, with certainty level C, (2) low mineral resource potential for coal, with certainty level C, and (3) low mineral resource potential for uranium and vanadium, for oil and gas, and for geothermal resources, with certainty level B

CORRELATION OF MAP UNITS

Qal, Qcl — Holocene; Qg — Pleistocene } QUATERNARY
Unconformity
Tp, Tps, Tpm — Eocene } TERTIARY
Unconformity
Kmv
Unconformity
Kmm, Kme, Kmbg
Unconformity
Kmf, Kmt, Kd — Upper Cretaceous } CRETACEOUS
Unconformity
Jmb, Jms — Upper Jurassic
Unconformity
Js
Unconformity
Je, Jc — Middle Jurassic
Unconformity
Jn, Jk, Jw — Lower Jurassic } JURASSIC
Unconformity
Ꞧcu — Upper Triassic } TRIASSIC

DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene)**—Poorly sorted deposits of clay, silt, sand, and gravel deposited along stream courses

Qcl **Colluvium (Holocene)**—Talus, landslide debris, Toreva blocks, and unsorted boulders, gravel, sands, and mud; thickness 0–100 ft or more

Qg **Gravel deposits (Holocene and Pleistocene)**—Poorly sorted mud, sand, and gravel on pediment and terrace surfaces; thickness 0–50 ft

Tp **Diorite porphyry (Eocene)**—Intrusive complexes, laccoliths, and minor intrusive masses; K-Ar dates of 44 and 48 million years (Armstrong, 1969) and fission-track ages of 21.2–29.2 million years (Sullivan, 1987)

Tps **Diorite porphyry (Eocene)**—Irregular zone of complexly intruded radial dikes, sills, and minor intrusive masses of diorite porphyry and shattered sedimentary rocks in a zone surrounding the central intrusion

Tpm **Monzonite Porphyry (Eocene)**—Intrusives, dikes, and minor, intrusive satellite bodies; restricted to central stock area of Mount Pennell

Kmv **Mesaverde Formation (Upper Cretaceous)**—Yellowish-tan to light-brown, fine-grained sandstone; locally conglomeratic, with small pebbles of chert and quartzite; conspicuously crossbedded; forms cliffs; fluvial deposits; corresponds to Tarantula Mesa Sandstone of Smith (1983); approximate thickness 295–395 ft

Mancos Shale (Upper Cretaceous)—Vertically alternating marine and nonmarine units aggregating 3,200–3,600 ft in thickness:

Kmm **Masuk Member**—Yellowish-green to yellowish-gray, slightly bentonitic mudstone and local black, carbonaceous mudstone, interbedded with yellowish-gray, very fine- to fine-grained, crossbedded sandstone; forms slope; alluvial-plain deposits, may include some brackish-water estuarine deposits (Peterson and others, 1980); approximate thickness 600–685 ft

Kme **Emery Sandstone Member**—Light- to dark-brown, fine- to medium-grained sandstone; upper part interbedded with greenish-gray, laminated to thinly bedded mudstone, black carbonaceous mudstone, and coal seams; sandstone often thinly bedded or cross-stratified; generally forms alternating slopes and cliffs; marginal marine, lagoonal-paludal, and alluvial-plain deposits. Corresponds to Muley Canyon Sandstone Member of Mancos of Smith (1983); approximate thickness 300–445 ft

Kmbg **Blue Gate Member**—Gray to dark-gray bentonitic marine shale, horizontally laminated and(or) ripple cross-laminated; locally interbedded with very fine grained sandstone; forms broad slope; offshore marine deposits; approximate thickness 1100–1500 ft

Kmf **Ferron Sandstone Member**—Yellowish-gray to light-brown, fine- to medium-grained, laminated, crossbedded sandstone; upper part interbedded with black carbonaceous mudstone and coal beds; forms alternating slopes and cliffs; marginal marine, lagoonal-paludal, and alluvial-plain deposits; approximate thickness 200–385 ft

Kmt **Tununk Member**—Gray to bluish-gray bentonitic mudstone and silty shale locally interbedded with yellowish-gray, very fine grained to fine-grained, laminated to thin-bedded, calcareous sandstone; forms a broad bench; offshore marine deposits; approximate thickness 530–720 ft

Kd **Dakota Sandstone (Upper Cretaceous)**—Light-gray to light-brown, fine- to medium-grained sandstone and locally conglomeratic sandstone; sandstone moderately to well cemented, horizontally laminated and(or) crossbedded, and interbedded in lower part with black, carbonaceous mudstone and thin, subeconomic coal seams; forms cliffs and slopes; fluvial, lagoonal-paludal, and marginal marine deposits; thickness ranges from 0 to 90 ft or more

Morrison Formation (Upper Jurassic)—Continental deposits 265–655 ft thick:

Jmb **Brushy Basin Member**—Light-gray to gray-green and reddish-brown to purple bentonitic mudstone containing several lenses of chert-pebble conglomerate; forms slope; alluvial-plain, mudflat, and probable lacustrine deposits; approximate thickness 100–250 ft

Jms **Salt Wash Member**—Light-gray to light-brown, fine- to medium-grained, crossbedded or laminated sandstone, conglomeratic sandstone, and conglomerate; interstratified with grayish-green to reddish-brown siltstone and mudstone; locally a major uranium-bearing unit; forms cliffs; alluvial-plain, mudflat, and lacustrine deposits; approximate thickness 100–500 ft

Js **Summerville Formation (Middle Jurassic)**—Moderate-reddish-brown, laminated to very thin bedded mudstone and siltstone; locally contains light-gray to grayish-green gypsum lenses 0–3 ft thick; forms broad slopes with prominent cliff at top; shallow-water, restricted-marine and, locally, evaporite deposits; approximate thickness 130–250 ft

Je **Entrada Sandstone (Middle Jurassic)**—Reddish-orange to reddish-brown, very fine- to fine-grained sandstone and silty sandstone; very thin- to thick-bedded; generally forms slope; eolian and sabkha deposits; approximate thickness 300–700 ft

Jc **Carmel Formation (Middle Jurassic)**—Yellowish-orange to moderate-reddish-brown, very fine grained to fine-grained sandstone and dark-reddish-brown mudstone; locally contains gray to greenish-gray limestone and coarsely crystalline white gypsum; marine, tidal flat, and sabkha deposits; approximate thickness 100–625 ft

Glen Canyon Group (Lower Jurassic)—Has been assigned a Triassic and Jurassic age in adjacent mapped areas. Is assigned only to the Lower Jurassic on this map following work by Peterson and Pipiringos (1979) and Padian (1989):

Jn **Navajo Sandstone (Lower Jurassic)**—Light-gray to light-orange, fine- to medium-grained, well-sorted sandstone; thickly cross-bedded; locally contains minor lenses of mudstone, cherty limestone, or dolomite; forms cliffs; eolian and minor playa deposits; approximate thickness 500–820 ft

Jk **Kayenta Formation (Lower Jurassic)**—Reddish-orange to reddish-brown, fine- to medium-grained, crossbedded sandstone, and laminated sandy siltstone; interbedded with minor limestone and mudstone; forms ledges and steep slopes; largely fluvial deposits, locally includes overbank, lacustrine, sabkha, and eolian deposits; approximate thickness 240–330 ft

Jw **Wingate Sandstone (Lower Jurassic)**—Reddish-pink to reddish-orange, very fine grained to fine-grained, crossbedded sandstone; forms cliffs; eolian deposits; approximate thickness 280–380 ft

Chinle Formation (Upper Triassic)—Divided into two parts in many areas, each containing several members. Only upper part present in this area:

Ꞧcu **Upper part, undivided**—Comprises Church Rock, Owl Rock, and Petrified Forest Members:

Church Rock Member—Reddish-brown to reddish-orange siltstone; irregularly ripple laminated to thick bedded; intebedded with cross-stratified, fine- to coarse-grained sandstone; locally contains thin- to thick-bedded conglomerate and arkosic sandstone; fluvial and lacustrine deposits; approximate thickness 80–200 ft

Owl Rock Member—Pale-red to pale-reddish-brown siltstone and mudstone; interbedded with pale-red to light-greenish-gray, thin- to medium-bedded, cherty limestone; thin to medium bedded; locally contains limestone breccia; lacustrine deposits; approximate thickness 120–200 ft

Petrified Forest Member—Variegated bentonitic claystone; interbedded with minor amounts of clayey siltstone and fine- to medium-grained sandstone; thin to thick bedded; fluvial and lacustrine deposit, approximate thickness 50–200 ft

Contact—Dashed where approximately located

Normal fault—Dashed where approximately located

Strike and dip of beds:

25 **Apparent**

40 **Inclined**

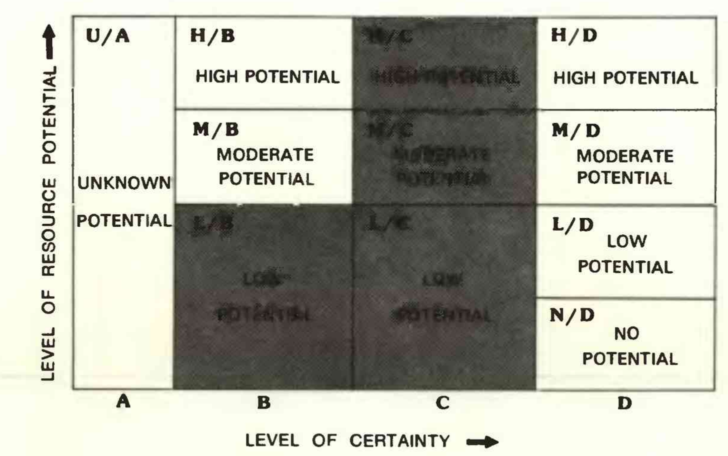
Surface openings:

Inaccessible adit

X **Prospect pit**

Trench

Shaft



LEVELS OF RESOURCE POTENTIAL

- **H** High mineral resource potential
- **M** Moderate mineral resource potential
- **L** Low mineral resource potential
- **U** Unknown mineral resource potential
- **N** No known mineral resource potential

LEVELS OF CERTAINTY

- **A** Available data not adequate
- **B** Data indicate geologic environment and suggest level of resource potential
- **C** Data indicate geologic environment, give good indication of level of resource potential, but do not establish activity of resource-forming processes
- **D** Data clearly define geologic environment and level of resource potential and indicate activity of resource-forming processes in all or part of the area

Diagram showing relationships between levels of mineral resource potential and levels of certainty. Shading shows levels that apply to this study area

SUBECONOMIC COAL RESOURCES, MINERAL RESOURCE POTENTIAL, AND GEOLOGY OF THE MOUNT PENNELL WILDERNESS STUDY AREA, GARFIELD COUNTY, UTAH